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Ma. Lourdes Q. Moreno
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Alvin S. Gestiada
Mark Angelo C. Bucay
Carmelita I. Villamor
Ma. Marcia M. Santillan

Handbook of Mangrove Resources in Pagbilao and Catanauan, Quezon

mangrove birds macrobenthos

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Program Leader: Carmelita I. Villamor, *Ph.D.*

Project Leader: Ma. Lourdes Q. Moreno, *Ph.D* .

Production Staff: *Mangrove Flora* - Alvin S. Gestiada
Riselle C. Ahillon-Evangelista

Birds - John Benrich M. Zuniga
Mark Angelo C. Bucay

Macrobenthos - Ma. Lourdes Q. Moreno
Ma. Marcia M. Santillan

Contributors: Primitiva A. Galupo
Jose Isidro Michael T. Padin
Annieraj G. Antong
Noel Angelo S. Arboleda
Yrah Joy C. Panizales
Rio Christine Bustamante
Ma. Kristina Orpia
Benjo S. Salvatierra

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Handbook of Mangrove Resources in Pagbilao and Catanauan, Quezon

Ma. Lourdes Q. Moreno, *Ph.D.*
John Benrich M. Zuñiga
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Mark Angelo C. Bucay
Carmelita I. Villamor, *Ph.D.*

Ecosystems Research and Development Bureau
Department of Environment and Natural Resources

Foreword

The Ecosystems Research and Development Bureau (ERDB), the research arm of the Department of Environment and Natural Resources (DENR), is mandated to conduct research and development programs to protect, conserve, and sustain our vital natural resources.

However, different studies have shown that our resources are continuously declining, in which our mangroves are no exception. Concurrently, with the onset of climate change, stronger typhoons hit the country affecting a multitude of lives and properties. Unfortunately, it is only during these times, that we come to ascertain the important role of mangroves as the first line of defense against coastal hazards such as storm surge.

With this, there is an urgent and strong need to create and disseminate information to understand mangroves and consequently conserve this important resource. This is because we cannot conserve our mangroves if we do not know what and how they work.

This handbook on mangrove resources in Pagbilao and Catanauan, Quezon upholds ERDB's commitment to help in conserving our natural resources. It contains basic technical know-how on mangrove resources for the benefit of mangrove researchers, managers, conservationists and enthusiasts.

It is the Bureau's privilege to be able to share mangrove knowledge from our researches to a wider audience. We further hope that this handbook will benefit mangrove rehabilitation and management endeavors geared towards the development, conservation and sustainability of our vital mangrove resources.

HENRY A. ADORNADO, *Ph.D.*
Director

Message

The Coastal Zone and Freshwater Ecosystem Research Division (CZFERD) wishes to extend our gratitude to the management of ERDB for the assistance in formulating this handbook. This field guide is in line with the division's mission in formulating and implementing R & D projects on mangrove and beach forests. It is our aim to generate information and technologies towards proper utilization, protection and rehabilitation of these resources.

This field guide focuses on the floral, avifaunal, and macrobenthic species composition of Pagbilao Mangrove Experimental Forest and Catanauan Mangrove Plantation. The two sites were studied to determine difference in terms of biodiversity between a natural mangrove forest and a mangrove plantation. This is an output of the project entitled, "Biodiversity Assessment of Selected Natural and Mangrove Plantation in Region IV-A" under the division's "Bioecological Profiling of Mangroves in Relation to Climate Change" program.

The creation of this handbook is in line with the growing need to preserve our mangrove resources. Although our mangroves suffered degradation due to uncontrolled utilization, numerous institutions are currently engaging to preserve the remaining mangrove stands and rehabilitate damaged areas.

May this book help everyone in achieving the goal of preserving and rehabilitating our mangrove forest for the sustenance of the Filipino community.

CARMELITA I. VILLAMOR, *Ph.D.*
Chief, Coastal Zone and Freshwater Ecosystems Research Division

Preface

Coastal areas are complex by nature, composed of various adjacent, interdependent and interrelated ecosystems from land to sea, each hosting a breadth of unique flora and fauna. Among these coastal ecosystems present in the Philippines are mangroves, defined as an ecosystem comprised of an assemblage of tropical trees and shrubs adapted to wet and saline habitats that grow within the intertidal zone. Mangroves are extremely vital actors in the fulfilment of provisioning, supporting, and regulating ecosystem services primarily serving as the breeding ground of aquatic organisms, as natural barriers against destructive wave action, and as an agent of sediment accretion and carbon sequestration; this importance holds especially true in the archipelagic context of the Philippines where majority of the population rely on coastal resources for sustenance and livelihood.

A major concern however is the deforestation that has occurred to Philippine mangroves after decades of illegal cutting, increased conversion of forest lands for aquaculture, and various unchecked anthropogenic factors leaving meagre coastal greenbelts unable to sustain coastal productivity and protect against devastating coastal perturbation. With the onset of the disastrous Typhoon Yolanda (International Name: Haiyan) leaving more than 6,500 dead and an estimated $ 12-15 billion worth of damages to infrastructure and agriculture, efforts to protect and rehabilitate our mangrove forests are gaining traction for the goal of increasing the resilience of vulnerable coastal communities.

In line with the current resurgence of interest in pursuing development projects concerning mangroves not only among public sector institutions but in the private sector and civil society as well. the Ecosystems Research and Development Bureau of the Department of Environment and Natural Resources ERDB presents this *Handbook of Mangrove Resources in Pagbilao and Catanauan, Quezon*.

It is a field reference detailing the diverse flora and fauna of the Pagbilao Mangrove Experimental Forest (PMEF)—the DENR-designated Genetic Resource Area and National Training Site for mangrove ecosystem (DAO 92-56) and the most botanically diverse mangrove forest in the country, and the Catanauan Mangrove Plantation—a 24-year old hundred hectare plantation forest which was the site of ERDB's Aqua-silviculture project.

The proponents of this project hope that this handbook will serve as a reliable field guide and a sufficient introduction to the diverse world of Philippine mangroves for everyone aspiring to pursue research and development work in this vital coastal ecosystem. Moreover, the authors aspire that through this publication, a wider audience of policymakers and development actors would be made aware of the country's status as a mangrove biodiversity hotspot leading to strengthened action towards protection and rehabilitation.

MA. LOURDES C. MORENO, *Ph.D.*
Section Chief, Mangrove and
Beach Forest Section, CZFERD

Acknowledgement

The authors would like to extend their gratitude for the generosity of the management of the Ecosystems Research and Development Bureau of the Environment and Natural Resources, headed by Dr. Henry A. Adornado. Acknowledgement is also given to Dr. Carmelita I. Villamor, Chief of the Coastal Zone and Freshwater Ecosystems Research Division, for facilitating the project implementation and serving as the program leader of the project.

We also wish to give thanks to the management of LaUFTeRC-ERDB (Pagbilao) headed by Ms. Marlene Melarpis for the cooperation and assistance during the data gathering.

Sincere gratitude is also given to the management of DENR-CENRO Pagbilao through Mr. Ramil Limpiada; PASU Pagbilao Ramil Gutierrez, Councilors and Brgy Captains of Brgy. Palsabangon Ibaba and Brgy. Pinagbayanan, Pagbilao, Quezon and to Brgy. Matandang Sabang Kanluran, Catanauan, Quezon, for the accommodation and assistance to the project team during the field visits.

Moreover, we would like to express our gratitude to all the individuals, groups, and friends whom we may have to mention for their contributions in making this handbook possible.

Purpose of the Handbook

Different mangrove projects were implemented by the Philippine government, non-government organizations, academes and private institutions on our country's mangrove ecosystems. These projects mainly focused on rehabilitation of mangroves to eventually increase the mangrove cover of the country. However, the challenges posed by the harsh coastal conditions and insufficient understanding of mangrove dynamics hinder most projects to maximize the output of rehabilitation projects *i.e.,* the survival of mangrove being planted. Particularly, one of the major problems met during the implementation of many mangrove rehabilitation projects is species-site mismatch. The need for a deeper understanding of mangroves particularly basic taxonomy and ecology among our researchers, environmental workers, students, etc. is then deemed necessary.

Hence, the Ecosystems Research and Development Bureau (ERDB) of DENR created this manual.

This manual aims to support anyone who will be planning to do research and/or rehabilitation projects on mangroves, specifically in terms of species identification. This could also serve as reference to properly and efficiently manage mangrove forest for its production, protection and conservation. This will also help implementers to prevent species-site mismatch and attain optimal achievement on their respective projects and activities.

This book contains the mangrove species recorded in Pagbilao Mangrove Experimental Forest and Matandang Sabang–Kanluran, Catanauan, Quezon as a result of a biodiversity assessments conducted in the two study sites. The two sites were selected to represent both natural mangrove forest and an established mangrove plantation. In addition, the said sites are important areas for research where, Pagbilao Mangrove Forest is described as the most diverse mangrove forest in the Philippines and Catanauan is a pioneer site of a successful aqua-silviculture project. Given, the importance of these sites, this handbook aims to stimulate further research on mangrove resources.

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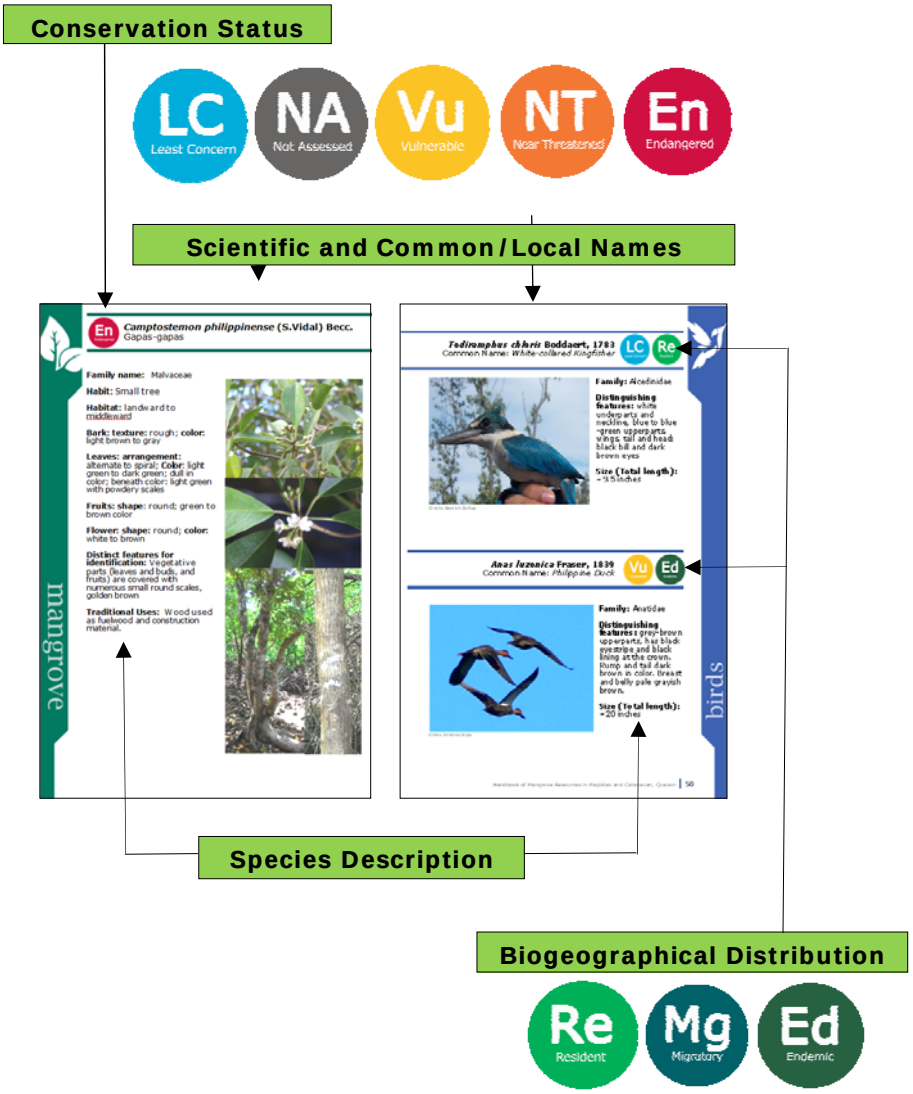
Abbreviations and Acronyms

CENRO	-	Community Environment and Natural Resources Office
CZFERD	-	Coastal Zone and Freshwater Ecosystems Research Division
DAO	-	DENR Administrative Order
DENR	-	Department of Environment and Natural Resources
ERDB	-	Ecosystems Research and Development Bureau
FAO	-	Food and Agriculture Organization
FMB	-	Forest Management Bureau
IUCN	-	International Union for the Conservation of Nature
LAUFTeRC	-	Land Management, Agroforestry and Upland Farming Technology Research Center
NRMC	-	Natural Resources Management Center (now under NAMRIA-DENR)
PASU	-	Protected Areas Superintendent
PMEF	-	Pagbilao Mangrove Experimental Forest
RA	-	Republic Act
UPLB	-	University of the Philippines—Los Baños

How to use this handbook

This handbook is divided into three sections: [1] mangroves (true and mangrove associates), [2] birds and [3] macrobenthic fauna. It features full colored pictures and key characteristics for easy field identification. The scientific and common/local names of all species are provided and are arranged alphabetically according to family. The full list of observed species are shown in tables at the introduction of each section. The handbook also features icons for ease of reference:



How to use this handbook

Conservation Status:*

Least Concern **(LC)** - Lowest risk; includes widespread and abundant taxa

Not Assessed **(NA)** - Has not yet been evaluated against the criteria

Vulnerable **(Vu)** - High risk of endangerment in the wild.

Near Threatened **(NT)** - Likely to become endangered in the near future

Endangered **(En)** - High risk of extinction in the wild

*Source: IUCN, 2016.

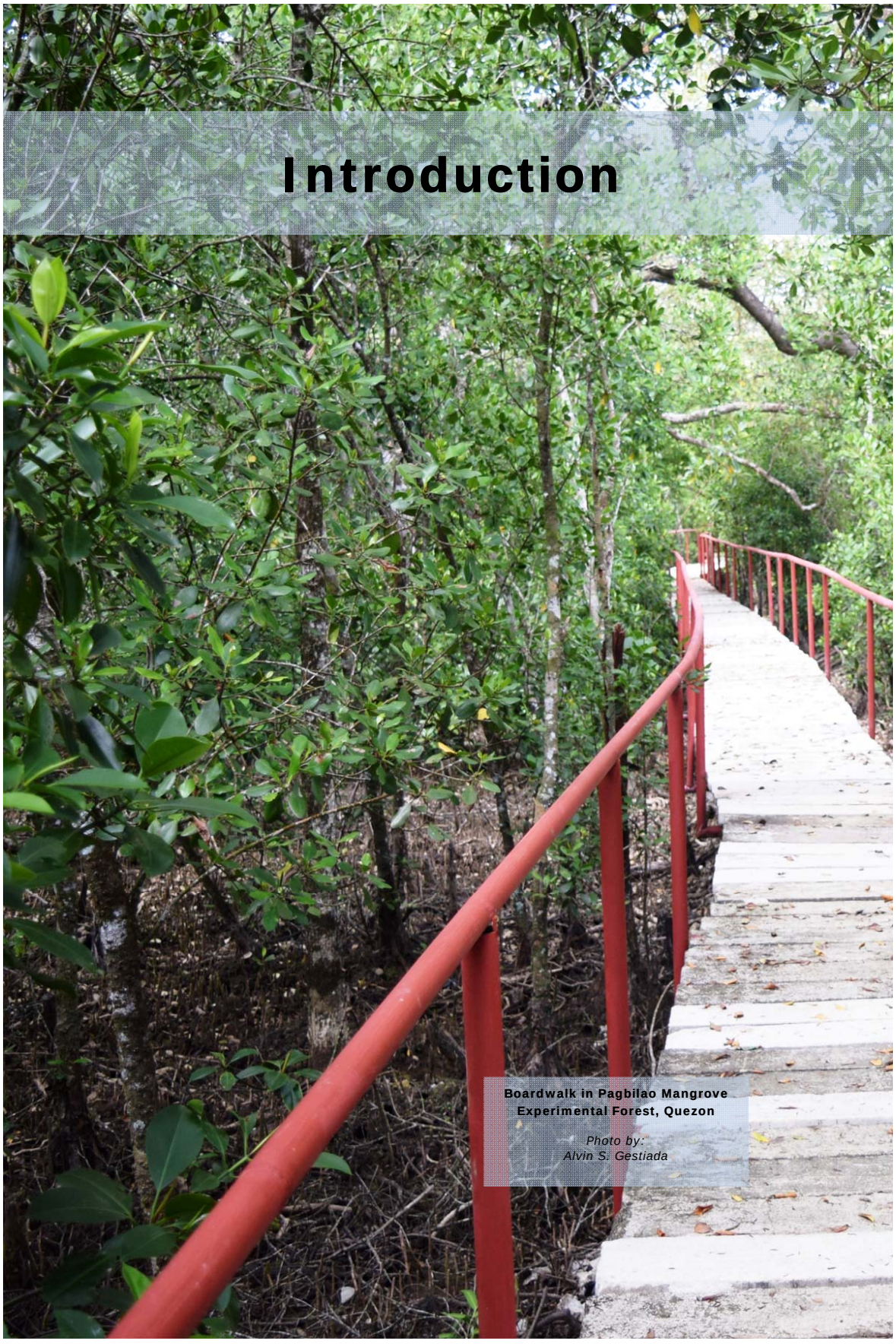
Biogeographical Distribution:

Endemic **(Ed)**- species found only in the Philippines;

Migratory **(Mg)** - Populations visiting the Philippines during migration season;

Resident **(Re)** - found in other countries/islands including the Philippines

Introduction



Boardwalk in Pagbilao Mangrove Experimental Forest, Quezon

Photo by:
Alvin S. Gestiada

Introduction

The Mangrove Ecosystem

Mangroves are plant species that are adapted to live in tidal conditions. They are found in coastal areas, sheltered estuaries, river banks, and lagoons (Tomlinson 1986). Specifically, mangroves can be found in intertidal zones along the tropical and subtropical coastlines (Kauffman and Donato, 2012). These tree species are found to thrive in warm waters with temperatures greater than 24°C (Primavera et al. 2004).

Mangrove forest is divided, although without distinct boundaries, into three zones: landward, middleward, and seaward. The landward zone is generally composed of species with buttress roots such as some of the *Xylocarpus* species; the middleward zone has trees with stilt roots such as those of the *Rhizophora* species; and the seaward zone has species with pneumatophotes such as those that belong in the genus *Sonneratia*. Hence, in each portion, species composition varies, dependent on their ability to tolerate and adapt the salinity of seawaters (Giensen et al. 2006).

Mangroves have long been utilized by coastal communities in a variety of ways. Some of the benefits include the provisioning of food (e.g. fishes and crustaceans), timber, and non-timber forest products (Walters et al. 2008). Mangroves also protect communities from hazards such as coastal erosion and storm surges. Other ecosystem services provided by the mangrove forests include carbon sequestration and sediment accretion.

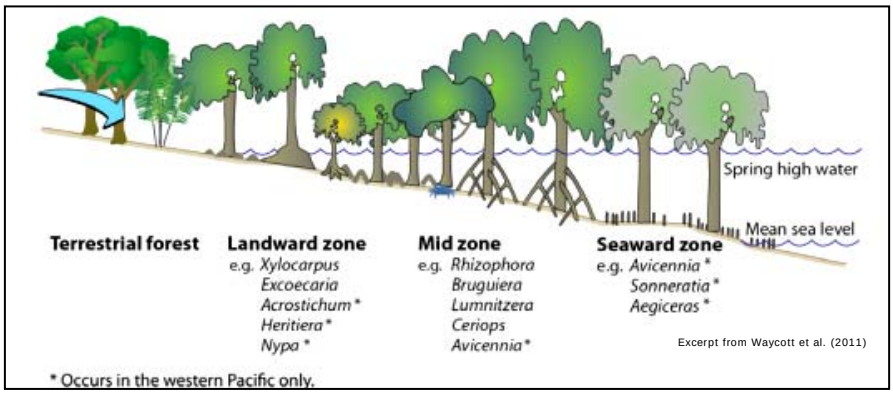


Figure 1. Occurrence of mangrove species in each zonation.

These ecosystem serves as habitat, breeding, and chick-rearing grounds for several bird species. The abundance of fishes and shellfishes makes the mangrove forest an ideal foraging ground for birds (Zakaria and Rajpar 2015). The microhabitats in mangrove forests cover a variety of environments that is suitable for macrobenthic species to thrive. Molluscs, crustaceans, polychaetes and small fishes thrive in the hard substrata offered by the trunk, aerial roots and foliage of mangrove trees, and the soft sediment where fine and shallow nutritive roots spread out. These microhabitats were often modified through different activities of these faunal species such as the formation of burrows of some crustaceans (Lee 2008).

Philippine Mangrove Forests

The Philippine mangrove ecosystem is one of the most diverse in the world in terms of species richness (Abantao et al. 2015). According to Primavera (2004), among the total of 70 mangrove species in the world, around 35-40 can be found in the Philippines. Fernando and Pancho (1980) created a dichotomous key for a total of 40 species (39 species and 1 variety) of mangrove flora in the Philippines. The Forest Management Bureau (FMB) estimated that the mangrove forests of the country cover a total of 311,000 hectares.

The country's mangrove cover drastically declined during 1950s-1960s due to lack of proper regulation. This rapid decline is one of the reasons that prompted the Philippine government to institutionalize the RA 7161, or the Revised Forestry Code of the Philippines, stipulated on this law is the total log ban of all mangrove species in the Philippines.

Despite the benefits that these mangroves provide and the law indicating these mangroves' protection, threats on these ecosystems remains. One such predicament is the destruction of mangrove forests due to intensive establishment of fish ponds and its accompanied pollution (Garcia et al. 2014). Other unregulated changes of land use such as coastal reclamation and unplanned human settlements have also hastened mangrove cover degradation in the country.

Pagbilao Mangrove Experimental Forest

Study Site 1:

Pagbilao Mangrove Experimental Forest (PMEF) approximately lies at 13”57’ and 121”42’. Pagbilao Mangrove forest is a mangrove forest located at Brgy. Ibabang Palsabangon, Pagbilao. Originally it spanned a total of 693 hectares, until 297 hectares of this become privately owned (RP-German FRI Project 1897) and what remained was the experimental forest under the management of Department of Environment and Natural Resources.

PMEF was designated as the Genetic Resource Area and National Training site for mangroves in 1992. It has been known to be the most botanically diverse in terms of true and associated mangrove species and in terms of variety of the nature of topography and substrate compared to other mangrove ecosystems in the country (NRMC 1980). Janssen and Padilla (1996) reported that 19 true mangrove species or 56% of the total true mangrove species of the country was observed in PMEF. The latest assessment by Almazol et al. (2012) accounts a total of 37 species identified in all zones of the PMEF.

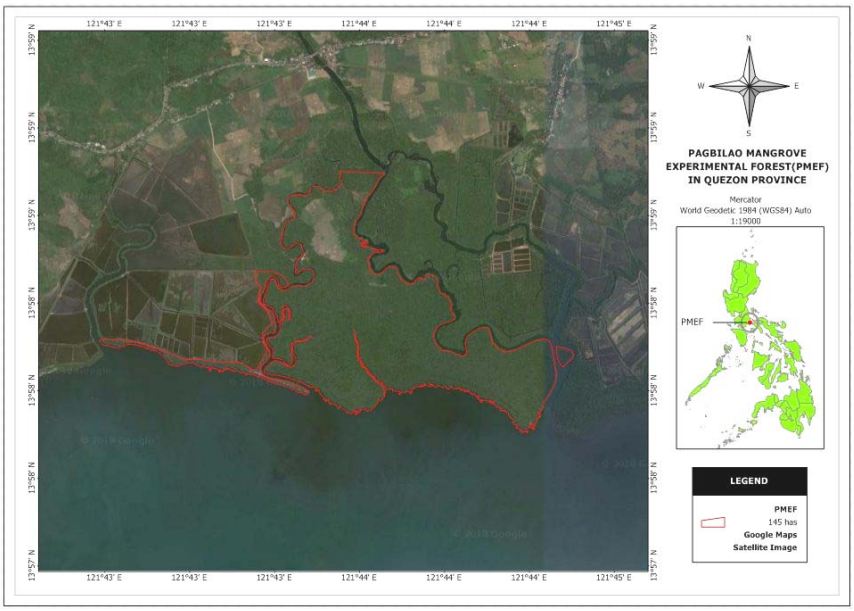


Figure 2. Location map of Pagbilao Mangrove Experimental Forest, Quezon, Philippines

Catanauan Mangrove Plantation

Study Site 2:

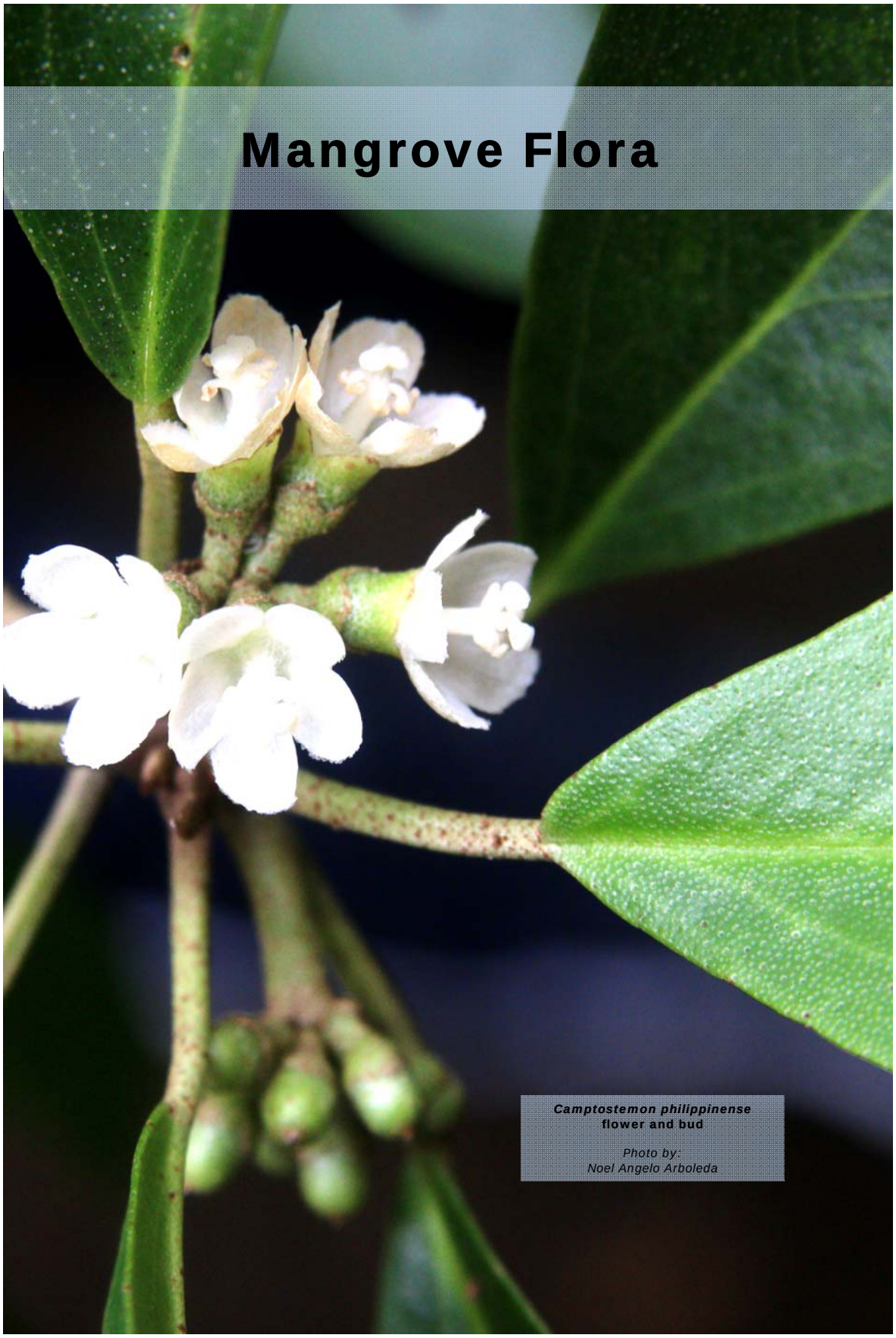
Catanauan Mangrove Plantation is situated approximately at 13°34'N and 122°16'E in Brgy. Matandang Sabang Kanluran, Catanauan, Quezon. The said area is a 24-year old plantation forest and is about a hundred hectares of land.

In 1994, ERDB pioneered a 0.8 ha aqua-silviculture project in Catanauan, Quezon and Sta Elena, Camarines Norte. It employed the 60:40 ratio of mangrove plantation to fishpond and had been completed and turned over to their respective local mangrove association.

Only a few studies have been conducted in the Catanauan mangrove forest, therefore, there is limited data available for this area. Hence, the conduct of further studies are recommended in the area, in particular, research concerning the dynamics of a mangrove plantation.

Figure 3. Location Map of Catanauan Mangrove Plantation, Quezon, Philippines

Mangrove Flora



Camptostemon philippinense
flower and bud

Photo by:
Noel Angelo Arboleda

MANGROVES AND ASSOCIATES

A total of 45 species belonging to 19 families were observed in a natural and planted mangrove forests located in Brgy. Ibabang Palsabangon, Pagbilao and Matandang Sabang-Kanluran, Catanauan both located in Quezon Province. Out of this, there were 29 true mangrove species and the other 16 were associate species. In comparison, there are about 35-40 species of mangroves recorded in the Philippines.

The list of true mangroves described in this handbook is based on the described true mangrove species in Southeast Asia published by Geisen et al. 2006. Table 1 shows the list of identified 'true' mangrove species with their scientific and common names. Also indicated is their presence between the two sites.

Table 1. True mangrove species observed in Pagbilao and Catanauan, Quezon, Philippines.

True Mangroves				
Family Name	**Scientific Name**	**Common Name**	**Pagbilao**	**Catanauan**
Acanthaceae	*Acanthus ebracteatus* Vahl	Tigbau	X	X
Acanthaceae	*Avicennia marina (Forsk.)* Vierh.	Bungalon	X	X
Acanthaceae	*Avicennia marina* var. *rumphiana* (Hallier f.) Bakh.	Piapi	X	X
Acanthaceae	*Avicennia officinalis* L.	Api-api	X	X
Arecaceae	*Nypa fruticans* Wurmb	Nipa	X	
Bignoniaceae	*Dolichandrone spathacea* (L.f.) Seem.	Tui	X	
Combretaceae	*Lumnitzera littorea* (Jack) Voigt.	Tabau	X	X
Combretaceae	*Lumnitzera racemosa* Willd	Kulasi	X	X
Euphorbiaceae	*Excoecaria agallocha* L.	Buta-buta	X	X
Lythraceae	*Sonneratia alba* Sm	Pagtpat	X	X

*X = present in the area

Continuation...

True Mangroves				
Family Name	**Scientific Name**	**Common Name**	**Pagbilao**	**Catanauan**
Malvaceae	*Camptostemon philippinense* (Vidal) Becc.	Gapas gapas	X	X
Malvaceae	*Heritiera littoralis* Aiton	Dungon-late	X	X
Meliaceae	*Xylocarpus granatum* Koen.	Tabigi	X	X
Meliaceae	*Xylocarpus moluccensis* (Lam.) M.Roem	Piagau	X	
Meliaceae	*Xylocarpus rumphii* (Kostel.) Mabb.	Malapiagau	X	X
Primulaceae	*Aegiceras corniculatum* (L.) Blanco	Saging-saging	X	X
Primulaceae	*Aegiceras floridum* Roem. and Schult.	Tinduk tindukan	X	X
Myrtaceae	*Osbornia octodonta* F. Muell.	Taualis	X	
Rhizophoraceae	*Bruguiera cylindrica* (L.) Blume	Pototan-lalake	X	
Rhizophoraceae	*Bruguiera gymnorhiza* (L.) Lam.	Busain	X	X
Rhizophoraceae	*Bruguiera parviflora (*Roxb.) Wight & Arn. ex Griff.	Langarai	X	X
Rhizophoraceae	*Bruguiera sexangula* (Lour.) Poir	Pototan	X	X
Rhizophoraceae	*Cerops zippeliana* Blume	Malatangal	X	X
Rhizophoraceae	*Ceriops tagal* (Perr.) C.B. Rob.	Tangal	X	X
Rhizophoraceae	*Kandelia candel* (L.) Druce	Bakauan-Baler	X	
Rhizophoraceae	*Rhizophora apiculata* Blume	Bakauan lalaki	X	X
Rhizophoraceae	*Rhizophra mucronata* Lam	Bakauan babae	X	X
Rhizophoraceae	*Rhizophora stylosa* Griff.	Bakauan bato	X	X
Rubiaceae	*Scyphiphora hydrophyllacea*	Nilad	X	X

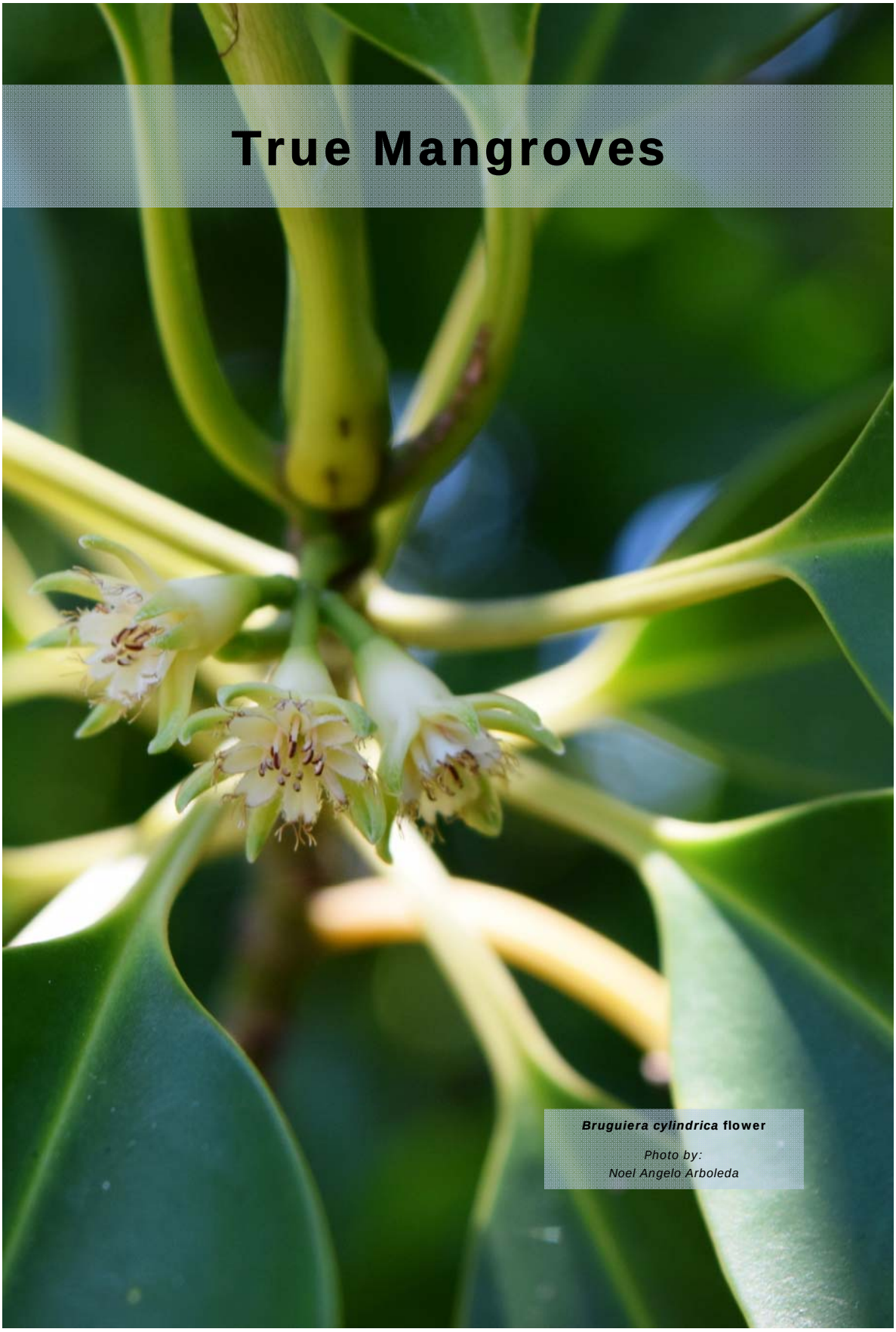
*X = present in the area

Table 2. Mangrove associate species observed in Pagbilao and Catanauan, Quezon, Philippines.

Mangrove Associates				
Family Name	**Scientific Name**	**Common Name**	**Pagbilao**	**Catanauan**
Aizoaceae	*Sesuvium portulacastrum* (L.) L.	Dampalit	X	X
Arecaceae	*Corypha utan* Lam.	Buri	X	
Arecaceae	*Cocos nucifera* L.	Nyog	X	X
Clusiaceae	*Calophyllum inophyllum* L.	Bitaog	X	
Combretaceae	*Terminalia catappa* L.	Talisay	X	X
Flagellariaceae	*Flagellaria indica* L	Baling-uway	X	
Leguminosae	*Sindora supa* Merr	Supa	X	
Leguminosae	*Intsia bijuga* var. *retusa* (Kurz) Sanjappa	Ipil Laut	X	
Leguminosae	*Intsia bijuga* (Colebr.) Kuntze	Ipil	X	
Leguminosae	*Pongamia pinnata* (L.) Pierre	Bani	X	X
Leguminosae	*Cynometra ramiflora* L.	Balitbitan	X	
Leguminosae	*Erythrina variegata* L.	Dapdap	X	
Myrtaceae	*Syzygium confertum* (Korth.) Merr. & L.M. Perry	Tamo	X	
Primulaceae	*Rapanea* sp.	Cape Beech	X	
Rubiaceae	*Morinda citrifolia* L.	Bangkoro	X	X
Rubiaceae	*Ixora philippinensis* Merr.	Santan Da-gat	X	

*X = present in the area

True Mangroves



***Bruguiera cylindrica* flower**

Photo by:
Noel Angelo Arboleda

Acanthus ebracteatus Vahl

Local name: *Tigbau*

Family name: Acanthaceae

Habit: shrub

Habitat: soft mud substrate; found in intermediate estuaries (middleward to landward).

Leaves: ***arrangement:*** simple, opposite and decussate; ***color:*** dark green; ***texture****:* smooth, shiny; ***blade shape****:* elliptic; serrate

Flower: ***color:*** blue, purple or white; ***inflorescence****:* spike

Fruits: ***shape:*** capsule; ***color:*** light to dark green

Distinct feature for identification: spine extensions of serrated leafblades.

© Alvin Gestiada

***Avicennia marina* (Forssk.) Vierh**

Local name: *Bungalon*

LC Least Concern

© John Benrich Zuniga

Family name : Acanthaceae*

Habit: small tree

Habitat: mostly seaward but can occur up to the landward zone.

Bark: ***texture:*** smooth to slighty flaky; ***color:*** light gray to brown.

Leaves: ***arrangement:*** simple, opposite; ***color:*** golden brown underneath; ***blade shape:*** slightly acute at tip

Flower: ***color:*** orange-yellow to pale-yellow; ***inflorescence****:* capitulum or head

Fruits: ***shape:*** heart; ***form:*** slightly flattened, usually curved when young

Distinct feature for identification: flaky bark.

Traditional Uses: smoke from dried branches is used as mosquito repellant; Leaves are used for livestock.

**Formerly under Avicenniaceae, now categorized under Acanthaceae (Das et al. 2015)*

Avicennia marina var. *rumphiana* (Hallier f.) Bakh.

Local name: *Piapi*

Family name : Acanthaceae*

Habit: medium to large tree

Habitat: muddy substrate; middleward to landward

Bark: ***texture:*** smooth to slighty flaky; ***color:*** light gray to brown

Leaves: *shape:* oblong with obtuse to rounded apex; petioles usually longer than *Avicennia marina*;

Flower: yellow and fragrant compared to other *Avicennia spp*.

Fruits: *shape:* heart; ***form:*** slightly flattened, curled when young

Distinct features for identification: abaxial side of leaf light green in color.

Traditional Uses: wood is used as fuel wood and material in furniture making (because of its fine wood grains).

© John Benrich Zuñiga

**Formerly under Avicenniaceae, now categorized under Acanthaceae (Das et al. 2015)*

***Avicennia officinalis* L.**

Local name: *Api-api*

© John Benrich Zuñiga

Family name : Acanthaceae*

Habit: medium sized tree

Habitat: firm mud substrate; middleward to landward

Bark: ***texture:*** smooth to slightly cracked; ***color:*** dark brown to dark gray

Leaves: ***arrangement****:* simple, opposite; ***color:*** golden brown underneath; ***shape:*** obovate to broadly oblong, often rounded at the apex;

Flower: orange-yellow

Fruits: ***shape:*** heart; ***Form:*** marginally flattened

Distinct features for identification: abaxial side of leaf dark yellow-brown in color.

Traditional Uses: wood is used to smoke fish and build rice mortars and pestles. Fruits are used as astringent. Bark and roots as aphrodisiac and seeds and roots as poultice in treating ulcers etc.

**Formerly under Avicenniaceae, now categorized under Acanthaceae (Das et al. 2015)*

Nypa fruticans Wurmb

Local name: *Nipa*

Family name: Arecaceae

Habit: Shrubby palm

Habitat: along the creeks of brackish to tidal waters and rivers

Bark: texture: smooth to slightly cracked; **color:** dark brown to dark gray

Leaves: ***arrangement****:* pinnate; ***color:*** green; shiny and smooth; ***form****:* no spines

Flower: globular inflorescence of female flowers; below are male flowers which are catkin-like.

Fruits: ***shape****:* egg-shaped; ***form:*** angular

Distinct feature for identification: unmistakable, only mangrove with palm characteristics.

Traditional Uses: has been widely used in fermentation process for tuba and vinegar making. Used as materials in making baskets and hats; also used as

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Dolichandrone spathacea (L.f.) Seem.

Local name: *Tui*

LC Least Concern

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Family name: Bignoniaceae

Habit: small tree

Habitat: landward; along riverbanks

Bark: ***texture:*** narrowly ridged; ***color:*** gray

Leaves: ***arrangement:*** odd-pinnate; ***leaves***: corrugated with distinctly limited nodes

Flower: ***Shape:*** trumpet-like; ***color:*** white

Fruits: ***shape:*** encapsulated in pod; ***form:*** bowed

Traditional Uses: bark is used as fish poison. Fresh bark and leaves are used as poultice to cure flatulence of women after childbirth.

Lumnitzera littorea (Jack) Voigt L.

Local name: *Tabau*

Family name: Combretaceae

Habit: small to medium

Habitat: inner edges of the swamp; along river banks

Bark: ***texture:*** fissured; ***color:*** light brown to gray

Leaves: ***arrangement:*** simple, alternate fleshy; ***shape:*** obovate

Flower: ***shape:*** (terminal inflorescence) pedicellate flowers; ***Color:*** reddish

Traditional Uses: water from boiled leaves is used in treating infant thrush. Wood is used for smoking fish and for heavy construction material.

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***Lumnitzera racemosa* Willd**

Local name: *Kulasi*

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Family name: Combretaceae

Habit: small tree

Habitat: inner edges; sandy portions of swamp

Bark: ***texture:*** fissured; ***color:*** brown

Leaves: similar with *L. littorea*

Flower: axillary; ***inflorescence****:* sessile flowers; ***color:*** white

Traditional Uses: used as living fence like/with *B. cylindrica.*

Excoecaria agallocha L.

Local name: *Buta-buta*

Family name: Euphorbiaceae

Habit: small tree

Habitat: inner edges of swamp; firm mud or sand

Bark: ***texture:*** light brown

Leaves: ***arrangement:*** simple, alternate fleshy

Flower: ***shape:*** catkin; (inflorescence) axillary; ***color:*** yellow.

Fruit: *small, round and green*

Traditional Uses: milky sap can cause skin irritation, alleged blindness and is poisonous. Twigs are used as pest repellent. Leaves are used to treat epilepsy. Sap can also be used to treat ulcer and toothache.

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***Sonneratia alba* Sm**

Local name: *Pagatpat*

LC Least Concern

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Family name: Lythraceae

Habit: Medium-sized tree

Habitat: generally in parts exposed to tidal waves

Bark: *color:* dark brown

Leaves: *arrangement:* simple; opposite; ***shape & texture****:* green (both surface); leathery; nose cone at apex.

Flower: *color:* whitish; ***arrangement****:* axillary clusters

Fruit: *calyx:* flattened in fruit.

Traditional Uses: wood is used as material for housing construction, furnishing and musical instruments.

En
Endangered

Camptostemon philippinense (S.Vidal) Becc.

Local name: *Gapas-gapas*

Family name: Malvaceae

Habit: small tree

Habitat: landward to middleward

Bark: ***texture:*** rough; ***color:*** light brown to gray

Leaves: ***arrangement:*** alternate to spiral; ***color****:* light green to dark green; dull in color; beneath color: light green with powdery scales

Fruits: round and green to brown color

Flower: ***shape:*** round; ***color:*** white to brown

Distinct features for identification: vegetative parts (leaves and buds, and fruits) are covered with numerous small round scales.

Traditional Uses: wood is used as fuelwood and construction material.

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***Heritiera littoralis* Aiton**

Local name: *Dungon-late*

LC Least Concern

© Riselle Ahillon-Evangelista

Family name : Malvaceae

Habit: medium-sized tree

Habitat: dryland; landward

Bark: ***texture:*** fissured-scaly;
color: light brown to brown

Leaves: ***arrangement:*** simple; alternate to spiral, ***color:*** dull green to dull green (surface); golden brown or silvery scaly (beneath)

Flower: ***arrangement****:* axillary panicles (Inflorescence)

Fruit: ***shape:*** distinctly keeled

Traditional Uses: wood is used for piles, bridges, and piers; roots as fish poison. Seed extract used to treat diarrhea and dysentery.

Xylocarpus granatum J.Koenig
Local name: *Tabigi*

Family name: Meliaceae

Habit: medium tree

Habitat: firm substrate; landward

Bark: ***texture:*** flaky**;** ***color:*** Light brown

Leaves: ***arrangement:*** even-pinnate; leathery leaflets

Flower: ***shape:*** panicle (mostly axillary); ***color:*** whitish to yellowish green

Fruit: ***shape:*** round; ***color:*** light green to light brown

Root structure: spreading root system; low buttress

Distinct features for identification: fruits look like a cannon ball; spreading root system; flaky bark resembles that of guava (*Psidium guajava).*

Traditional Uses: wood is used in making furniture due to its fine and glossy texture.

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Xylocarpus moluccensis (Lam.) M.Roem.

Local name: *Piagau*

LC Least Concern

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Family name: Meliaceae

Habit: small tree

Habitat: marginal areas in open shores

Bark: ***texture:*** fissured**;** ***color:*** dark brown

Leaves: ***arrangement****:* looked-like *X. granatum;* ***leaflets:*** herbaceous, thin, leathery

Flower: ***shape:*** panicle (mostly axillary); ***color:*** whitish to yellowish-green

Fruit: ***shape:*** round; ***color:*** light green

Root structure: ***shape:*** cone-shaped pneumatophores

Distinct features for identification: fruits look like a cannon ball but smaller than *X. granatum*. Cone-shaped pneumatophores

Traditional Uses: wood is used in making furniture due to its fine and glossy texture.

mangroves

NA
Not Assessed

Xylocarpus rumphii (Kostel.) Mabb.

Local name: *Malapiagau*

Family name: Meliaceae

Habit: small to medium tree

Habitat: sandy substrate

Bark: ***texture:*** fissured**;** ***color:*** brown to dark brown

Leaves: ***arrangement:*** similar to *X. moluccensis* but apex is pointed

Flower: panicle (mostly axillary); ***color:*** yellowish-green

Fruit: ***shape****:* round; ***color****:* shiny green

Distinct features for identification: tree similar to *X. moluccensis* but with the absence of pneumatophores.

Traditional Uses: dye used for textile. Wood is used as material for house, furniture and even boat construction.

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Aegiceras corniculatum (L.) Blanco

Local name: *Saging-saging*

LC Least Concern

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Family name: Primulaceae

Habit: Small tree

Habitat: water channels; inner parts of swamp; and in sandy spots (middleward)

Bark: ***texture:*** lenticellate**;** ***color:*** dark brown to black

Leaves: ***arrangement:*** alternate; ***shape:*** obovate; Texture: leathery

Flower: ***shape****:* round (clustering); ***inflorescence:*** umbel; ***color:*** white

Fruit: ***shape:*** strongly curved; ***color:*** red; whitish/yellowish to light green

Root structure: adventitious

Distinct features for identification: lenticillate, dark brown to black bark. Fruit looked-like tiny bananas. Leaves have salt deposits.

Traditional Uses: wood is used as firewood and bark for tanning and fish poison.

Aegiceras floridum Roem. & Schult

NT Near Threatened

Local name: *Tinduk-tindukan*

Family name: Primulaceae

Habit: small tree

Habitat: along water channels; inner parts of the swamp or sandy spots

Bark: ***texture:*** lenticellate**;** ***color:*** light brown to creamy white (young); brown, dark brown to grayish (matured)

Leaves: ***arrangement:*** alternate; ***shape****:* obovate; ***texture:*** leathery

Flower: ***shape:*** compound (raceme); ***color:*** white

Fruit: ***shape:*** slightly curved; ***color:*** red

Distinct features for identification: bark looks-like *A. corniculatum* but light brown to cream white in color; fruits resembles chili peppers.

Traditional Uses: used as fuelwood and bark has small amount for tannin.

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Osbornia octodonta F. Muell

Local name: *Taualis*

LC Least Concern

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Family name: Myrtaceae

Habit: small tree; forming thickets

Habitat: sandy shores; associated with *Avicennia* and *Sonneratia*; landward

Bark: ***texture:*** quite shaggy; ***color:*** reddish brown

Leaves: ***arrangement:*** opposite; ***shape:*** obovate; tiny; ***color:*** reddish petioles

Flower: ***shape:*** cyme (axillary); ***color:*** white to yellowish.

Distinct features for identification: shaggy bark

Traditional Uses: dried twigs are used as materials for basket making.
Wood used as fuelwood.

Bruguiera cylindrica (L.) Blume

Local name: *Pototan-lalake*

Family name: Rhizophoraceae

Habit: medium tree; shrubby

Habitat: stiff clay; inland portions (behind the shoreline species); (middleward to landward)

Bark: ***texture:*** ridged; few lenticels; ***colors:*** reddish brown to dark brown

Leaves: ***arrangement:*** opposite; ***color:*** dark green (shiny)

Flower: ***shape****:* Cyme (axillary); ***color:*** whitish; sepals: green (reflexed)

Roots: knee roots

Distinct features for identification: shrubby, flaky-low buttress, ridged bark.

Traditional Uses: used as source of tannin and as firewood.

***Bruguiera gymnorhiza* (L.) Lam.**

Local name: *Busain*

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Family name: Rhizophoraceae

Habitt: medium tree

Habitat: stiff clay substrate; inland; landward

Branching: sympodial

Bark: ***texture:*** horizontally & vertically ridged; few lenticels; ***color:*** reddish brown to dark brown

Leaves: ***arrangement:*** opposite; ***stipules:*** reddish; **shape:** elliptic; ***texture:*** smooth; shiny

Flower: ***shape:*** solitary; ***color:*** pink to red

Fruit: ***color:*** reddish to purplish; with red cap

Roots: knee-roots

Distinct features for identification: has the largest leaf among *Bruguiera sp.* Pink to red sepals.

Traditional Uses: wood is used as charcoal and firewood. Knee roots are used for ritual planting.

Bruguiera parviflora (Roxb.) Wight & Arn. ex Griff.

Local name: *Langarai*

Family name: Rhizophoraceae

Habit: small to medium tree

Habitat: firm mud flats; inner side of swamp; with *Rhizophora* species; landward

Branching: monopodial

Leaves: ***arrangement:*** opposite; ***color:*** yellowish-green

Flower: yellowish

Fruit: light green

Distinct features for identification: size of leaves is like *B. cylindrica* but more elongated and yellowish green in color.

Traditional Uses: source of tannin. Wood is used as foundation pilings, house posts, flooring and cabinet works.

***Bruguiera sexangula* (Lour.) Poir.**
Local name: *Pototan*

Family name : Rhizophoraceae

Habit: medium tree

Habitat: firm mud flats inland (middleward to landward)

Bark: ***texture:*** rough; copious presence of large lenticels

Leaves: ***arrangement:*** opposite; ***color:*** yellowish to green

Flower: ***color:*** yellow to yellowish-brown (solitary)

Fruit: ***color:*** similar to *B. gymnorrhiza* but shorter and much swollen

Distinct features for identification: fruit much swollen and shorter than *B. gymnorrhiza*. Numerous lenticels in bark.

Traditional Uses: roots and leaves are used to treat burns and as incense. Leaves have alkaloids as tumor inhibitor. Lotion made from fruit is said to treat sore eyes. Fruit is used as betel nut substitute.

Ceriops zippeliana Blume

Local name: *Malatangal*

Family name: Rhizophoraceae

Habit: small tree; shrubby

Habitat: near mouths of tidal streams; muddy substrate; middleward to landward

Stem: slightly swollen at the base; ***bark:*** ridged (horizontally and vertically)

Leaves: ***arrangement:*** opposite; ***shape:*** broadly obovate; ***color:*** dark green (surface); yellowish to green (beneath)

Flower: ***shape/ arrangement:*** pedicellate; ***color:*** yellow to yellowish-brown (solitary)

Fruit: ***color:*** similar with *C. tagal* but erect or projected; short hypocotyl.

Distinct features for identification: fruit is erect and projected.

Traditional Use: bark powder is used in making local *tuba* in Panay.

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Ceriops tagal (Perr.) C.B. Rob

Local name: *Tangal*

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Family name: Rhizophoraceae

Habit: small tree

Habitat: near mouths of tidal streams; muddy substrate; landward

Stem: slightly swollen at the base

Bark: ridged (horizontally and vertically)

Leaves: ***arrangement:*** opposite; ***shape****:* narrowly obovate; ***color:*** yellowish green

Flower: ***shape / arrangement:*** sessile

Fruit: ***calyx:*** reflexed

Distinct features for identification: look like *C. zippeliana* but it's fruit calyx is reflexed and longer.

Traditional Uses: bark powder is used in making local *tuba* in Panay.

***Kandelia candel* (L.) Druce**

Local name: *Bakauan Baler* (*Introduced in PMEF*)

Family name: Rhizophoraceae

Habit: small tree

habitat: lower intertidal zone; in soft mud; associated with *A. corniculatum*

Root: Stilt-root

Bark: ***color:*** brown; ***texture:*** lenticellate

Leaves: ***arrangement:*** opposit; ***shape****:* oblong; ***color****:* green to yellow green

Flower: ***shape/ arrangement:*** cyme, axillary

Fruit: propagules; ***calyx:*** reflexed

Distinct features for identification: calyx is reflexed. Root is flaky.

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***Rhizophora apiculata* Blume**
Local name: *Bakauan lalake*

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Family name : Rhizophoraceae

Habit: medium tree

Habitat: deep/ soft muddy flat; frequently flooded by the tides; middleward to landward

Bark: ***color:*** grayish brown

Leaves: ***arrangement:*** opposite; ***shape & texture:*** elliptic; acuminate apex; smooth; shiny; ***color:*** green to dark green; dark red (stipules)

Flower: ***shape / arrangement:*** cyme, axillary (inflorescence)

Fruit: has yellowish collar

Root: prominent stilt roots

Distinct features for identification: leaves have small black dots. Prominent stilt roots. Leaves same with that of *R. mucronata* but has acuminate apex.

Traditional Uses: leaves are used in feeding pigs.

***Rhizophora mucronata* Lam.**

Local name: *Bakauan babae*

Family name: Rhizophoraceae

Habit: medium tree

Habitat: along banks of tidal streams; estuaries; rare in inland

Bark: ***color:*** grayish brown

Leaves: ***arrangement:*** opposite; ***shape & texture:*** elliptic; mucronate apex; smooth; shiny; ***color:*** reddish to yellowish green (stipules and midrib)

Flower: attached on slender stalk

Roots: prominent stilt roots

Distinct features for identification: leaves have small black dots; prominent stilt roots; leaves have pointed tip (mucronate). Apical shoot yellowish in color.

Traditional Uses: from 1950's to 1970's, it is used as source of materials in rayon fiber factories exported to Japan**.** Dried hypocotyls are used as cigars.

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***Rhizophora stylosa* Griff.**

Local name: *Bakauan bato*

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Family name: Rhizophoraceae

Habit: small-sized tree

Habitat: sandy shores; coral terraces; seaward

Bark: ***color:*** grayish brown

Leaves: ***arrangement:*** opposite; ***shape & texture****:* elliptic, apex: mucronate; smooth; shiny; ***color:*** pure red (stipules and midrib); long styles

Flower: attached on slender stalk

Roots: prominent stilt roots

Distinct features for identification: leaves and inflorescence same as in *R. mucronata,* but flowers with longer styles.

Traditional Uses: used as fuelwood and dyes.

mangroves

Scyphiphora hydrophylacea C. F. Gaertn.

Local name: *Nilad*

Family name: Rubiaceae

Habit: small tree

Habitat: Along river banks; firm muddy or sandy soil

Leaves: ***arrangement:*** simple; opposite; ***shape & texture:*** obovate; very shiny surface; Leaf buds: flatted, sticky

Flower: ***color:*** whitish; ***arrangement:*** axillary clusters

Fruit: ***shape:*** grooved or ribbed

Distinct features for identification: adaxial side of leaves shiny. Reclining trunk as it matures

Traditional Uses: young leaves and petioles are used as forage for goats and other livestock.

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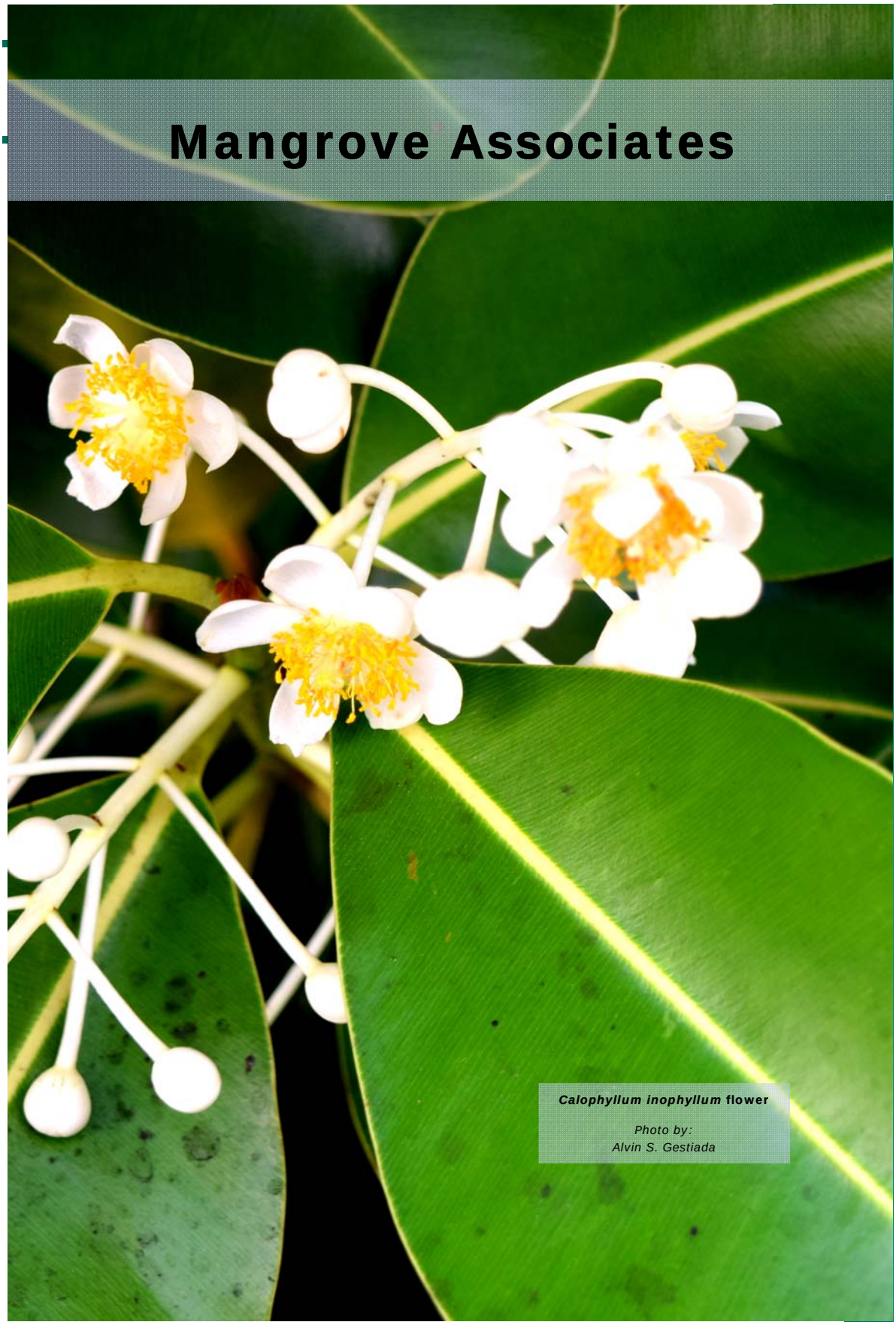
Mangrove Associates



***Calophyllum inophyllum* flower**

Photo by:
Alvin S. Gestiada

Family name:
Aizoaceae

Scientific name:
***Sesuvium portulacastrum* (L.) L.**

Common name:
Dampalit

Family name:
Arecaceae

Scientific name:
***Corypha utan* Lam.**

Common name:
Buri

Photo source:
www.stuartxchange.org

Family name:
Arecaceae

Scientific name:
***Cocos nucifera* L.**

Common name:
Niyog

Family name:
Clusiaceae

Scientific name:
***Calophyllum inophyllum* L.**

Common name:
Bitaog

Family name:
Combretaceae

Scientific name:
***Terminalia catappa* L.**

Common name:
Talisay

Family name:
Flagellariaceae

Scientific name:
***Flagellaria indica* L**

Common name:
Baling-uway

Family name:
Leguminosae

Scientific name:
***Sindora supa* Merr**

Common name:
Supa

Family name:
Leguminosae

Scientific name:
***Intsia bijuga* var. *retusa* (Kurz) Sanjappa**

Common name:
Ipil Laut

Family name:
Leguminosae

Scientific name:
***Intsia bijuga* (Colebr.) Kuntze**

Common name:
Ipil

Family name:
Leguminosae

Scientific name:
***Pongamia pinnata* (L.) Pierre**

Common name:
Bani

Photo source:
bioweb.uwlax.edu

Family name:
Leguminosae

Scientific name:
***Cynometra ramiflora* L.**

Common name:
Balitbitan

Photo source:
a. www.projectnoah.org
b. toptropicals.com

Family name:
Leguminosae

Scientific name:
***Erythrina variegata* L.**

Common name:
Dapdap

Family name:
Myrtaceae

Scientific name:
***Syzygium confertum* (Korth.) Merr. & L.M. Perry**

Common name:
Tamo

Family name:
Primulaceae

Scientific name:
Rapanea sp.

Common name:
Cape beech

Family name:
Rubiaceae

Scientific name:
***Morinda citrifolia* L.**

Common name:
Bangkoro

Family name:
Rubiaceae

Scientific name:
***Ixora philippinensis* Merr.**

Common name:
Philippine Santan

BIRDS

Whimbrels perched on *Rhizopora stylosa* in Catanauan Mangrove Plantation

Photo by:
John Benrich Zuñiga

BIRDS

Various studies have been done in relation with bird diversity and habitat quality. This is because birds are good indicators of habitat quality. They respond to habitat functions and there are species which are sensitive to habitat conditions. (BirdLife International 2013)

A total of 44 avifaunal species were identified in both mangrove forests. Specifically, 48 and 35 species were observed in Pagbilao and Catanauan, respectively. Table 3 shows the presence and absence of observed species in both the mangrove forests.

Table 3. Bird species species observed in Pagbilao and Catanauan, Quezon, Philippines.

Family	Scientific Name	Common Name	Pagbilao	Catanauan
Acanthizidae	*Gerygone sulphurea Wallace, 1864*	Golden-bellied Gerygone	X	X
Alcedinidae	*Alcedo atthis Linnaeus, 1758*	Common Kingfisher	X	X
Alcedinidae	*Todiramphus chloris Boddaert, 1783*	Collared Kingfisher	X	X
Anatidae	*Anas luzonica Fraser, 1839*	Philippine Duck	X	X
Apodidae	*Collocalia esculenta Linnaeus, 1758*	Glossy Swiftlet	X	X
Ardeidae	*Ardea cinerea Linnaeus, 1758*	Grey Heron	X	
Ardeidae	*Bubulcus ibis Linnaeus, 1758*	Cattle Egret	X	X
Ardeidae	*Butorides striata Linnaeus, 1758*	Little Heron	X	X
Ardeidae	*Egretta eulophotes Swinhoe, 1860*	Chinese egret	x	
Ardeidae	*Egretta garzetta Linnaeus, 1766*	Little Egret	X	X
Artamidae	*Artamus leucoryn Linnaeus, 1771*	White-breasted Wood-swallow	X	X

*X = presence of species in the area

Continuation...

Family	Scientific Name	Common Name	Pagbilao	Catanauan
Campephagidae	*Lalage nigra Forster, 1781*	Pied Triller	X	X
Cisticolidae	*Orthotomus castaneiceps Walden, 1872*	Philippine Tailorbird	X	
Columbidae	*Geopelia striata Linnaeus, 1766*	Zebra Dove	X	X
Columbidae	*Phapitreron leucotis Temminck, 1823*	White-Eared Brown Dove	X	X
Columbidae	*Spilopelia chinensis Scopoli, 1786*	Spotted-necked Dove		X
Columbidae	*Streptopelia tranquebarica Hermann, 1804*	Red Turtle dove		X
Columbidae	*Treron vernans Linnaeus, 1771*	Pink-necked Green-Pigeon		X
Corvidae	*Corvus macrorhynchos Wagler, 1827*	Large-billed Crow	X	X
Estrildidae	*Lonchura atricapilla Vieillot, 1807*	Chestnut Munia	X	X
Hirundinidae	*Hirundo rustica Linnaeus, 1758*	Barn Swallow	X	X
Hirundinidae	*Hirundo tahitica Gmelin, 1789*	Pacific Swallow	X	X
Laniidae	*Lanius cristatus Linnaeus, 1758*	Brown Shrike	X	X
Laridae	*Chlidonias leucopterus Temminck, 1815*	Common tern	X	X
Laridae	*Chlidonias hybrida Pallas, 1811*	Whiskered Tern	X	
Locustellidae	*Megalurus palustris Horsfield, 1821*	Striated Grassbird	X	X
Meropidae	*Merops viridis Linnaeus, 1758*	Blue-throated Bee-eater	X	X
Muscicapidae	*Copsychus saularis Linnaeus, 1758*	Oriental Magpie Robin	X	
Muscicapidae	*Cyornis rufigastra Raffles, 1822*	Mangrove Blue Flycatcher	X	

*X = presence of species in the area

Continuation...

Family	Scientific Name	Common Name	Pagbilao	Catanauan
Nectariniidae	*Cinnyris jugularis Linnaeus, 1766*	Olive-backed Sunbird	X	X
Oriolidae	*Oriolus chinensis Linnaeus, 1766*	Black-naped Oriole	X	X
Pandionidae	*Pandion haliaetus Linnaeus, 1758*	Osprey	X	X
Passeridae	*Passer montanus Linnaeus, 1758*	Eurasian Tree Sparrow	X	X
Psittacidae	*Bolbopsittacus lunulatus Scopoli, 1786*	Guaiabero		X
Pycnonotidae	*Pycnonotus goiavier Scopoli, 1786*	Yellow-Vented Bulbul	X	X
Rallidae	*Hypotaenidia torquata Linnaeus, 1766*	Barred Rail	X	X
Recurvirostridae	*Himantopus himantopus Linnaeus, 1758*	Black-winged stilt	X	
Rhipiduridae	*Rhipidura nigritorquis Vigors, 1831*	Philippine Pied Fantail	X	X
Scolopacidae	*Actitis hypoleucos Linnaeus, 1758*	Common Sandpiper	X	X
Scolopacidae	*Numenius phaeopus Linnaeus, 1758*	Whimbrel	X	X
Scolopacidae	*Tringa nebularia Gunnerus, 1767*	Common greenshank	X	
Scolopacidae	*Tringa totanus Linnaeus, 1758*	Common redshank	X	
Sturnidae	*Aplonis panayensis Scopoli, 1783*	Asian Glossy Starling	X	X
Sturnidae	*Acridotheres cristatellus Linnaeus, 1766*	Crested Myna	X	X

*X = presence of species in the area

***Todiramphus chloris* Boddaert, 1783**
Common Name: *White-collared Kingfisher*

LC Least Concern | Re Resident

© John Benrich Zuñiga

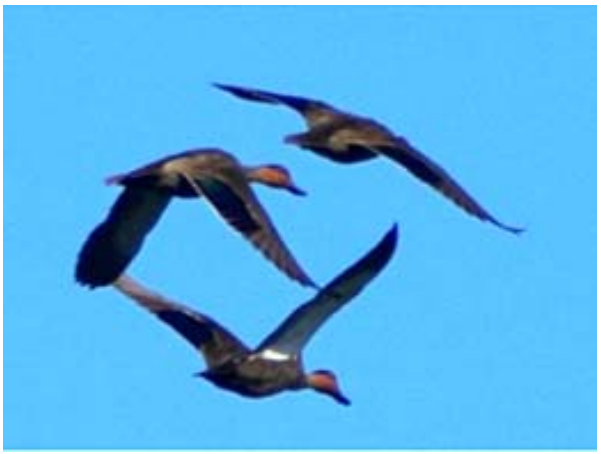
Family: Alcedinidae

Distinguishing features: white underparts and neckline, blue to blue -green upperparts, wings, tail and head Black bill and dark brown eyes

Size (Total length): ~9.5 inches

***Anas luzonica* Fraser, 1839**
Common Name: *Philippine Duck*

Vu Vulnerable | Ed Endemic



© Ma. Kristina Orpia

Family: Anatidae

Distinguishing features: grey-brown upperparts, has black eyestripe and black lining at the crown. Rump and tail dark brown in color. Breast and belly pale grayish brown.

Size (Total length): ~20 inches

Ardea cinerea Linnaeus, 1758

Common Name: *Grey Heron*

Family: Ardeidae

Distinguishing features: grey plumage at the back and wings but flight feathers are darker gray in color. Has a black line at the top of eye and two streak/ lines extending parallel to the neck.

Size (Total length): ~40 inches

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Butorides striata Linnaeus, 1758

Common Name: *Little Heron*

Family: Ardeidae

Distinguishing features: has grey-green back parts and a darker grey-black crown. Has a lining under the eye which extends from the lores past the eye. Has striations on wings.

Size (Total length): ~16.5 inches

© Ma. Kristina Orpia

***Egretta garzetta* Linnaeus, 1766**
Common Name: *Little Egret*

LC Least Concern | Mg Migratory

© Ma. Kristina Orpia

Family: Ardeidae

Distinguishing features: white plumage all throughout the body. Has black legs, yellow feet (distinguishing characteristic among other egrets) and black bill.

Size (Total length): ~24 inches

**Has both resident and migratory population*

***Artamus leucoryn* Linnaeus, 1771**
Common Name: *White-Breasted Woodswallow*

LC Least Concern | Re Resident

© John Benrich Zuñiga

Family: Artamidae

Distinguishing features: black head and extends up to upper back although a little lighter. White breast and belly. Silver-gray to blue-gray colored beak.

Size (Total length): ~7.5 inches

Lalage nigra Forster, 1781
Common Name: *Pied Triller*

Family: Campephagidae

Distinguishing features: grey-white underparts, eyes and lores. Blue-black head and upper back; females have greyish upperparts. Underparts have fine grey bars among females.

Size (Total length): ~6.5 inches

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Geopelia striata Linnaeus, 1766
Common Name: *Zebra Dove*

Family: Columbidae

Distinguishing features: black striations/patterns at the sides of chest, back and wings, hence its name. Over -all color is pale brown except for the white lower belly and undertail coverts and blue-gray cheek and throat.

© John Benrich Zuñiga

Size (Total length):

Spilopelia chinensis Scopoli, 1786
Common Name: *Spotted Dove*

© Yrah Joy Panizales

Family: Columbidae

Distinguishing features: back and body brown in color. Has broad black collar with spots but none at front of neck. Has grey crown and black lores.

Size (Total length): ~12 inches

Streptopelia tranquebarica Hermann, 1804
Common Name: *Red Turtle-Dove*

© John Benrich Zuniga

Family: Columbidae

Distinguishing features: wings, dorsal and ventral side of body pinkish-red in color. Has a narrow black collar that terminates at the front of neck. Blue-grey head and face and paler at forehead.

Size (Total length): ~9 inches

Treron vernans Linnaeus, 1771
Common Name: *Pink-Necked Green Pigeon*

Family: Columbidae

Distinguishing features: distinguished from other pigeons by pinkish to orange band at the breast. Olive green back, rump, lesser wing coverts and tertials

Size (Total length): ~9.75 inches

© Yrah Joy Panizales

Hirundo tahitica Gmelin, 1789
Common Name: *Pacific Swallow*

Family: Hirundinidae

Distinguishing features: distinguished from Barn Swallow by the absence of black band at the breast. Heavily forked tail which is a characteristic of swallows.

Size (Total length): ~5 inches

© Rio Christine Bustamante

***Lanius cristatus* Linnaeus, 1758**
Common Name: *Brown Shrike*

LC Least Concern | Re Resident

© Noel Angelo Arboleda

Family: Laniidae

Distinguishing features: brown-grey forehead, head and upperparts. Black stripe from lores to ear coverts. Faint golden-brown breast and belly. Females have bars on breast and flanks.

Size (Total length): ~7.5 inches

***Merops viridis* Linnaeus, 1758**
Common Name: *Blue-Throated Bee-Eater*

LC Least Concern | Re Resident

© John Benrich Zuñiga

Family: Meropidae

Distinguishing features: brown/ chestnut head and upper back. Has an extended central tail feathers, blue throat and has black stripe around the eye.

Size (Total length): ~11 inches

Cyornis rufigastra Raffles, 1822

Common Name: *Mangrove Blue Flycatcher*

Family: Muscicapidae

Distinguishing features: dorsal portion (crown, nape, back, wings and tail blue-black. Breast part orange. Belly to undertail coverts light orange.

Size (Total length): ~5.75 inches

© Alvin Gestiada

Cinnyris jugularis Linnaeus, 1766

Common Name: *Olive-Backed Sunbird*

Family: Nectarinidae

Distinguishing features: olive green back and yellow body (females). Males have metallic black-purple plumage at the throat up to upper chest.

Size (Total length): ~4.5 inches

© Mark Angelo Bucay

***Oriolus chinensis* Linnaeus, 1766**
Common Name: *Black-Naped Oriole*

LC Least Concern | Re Resident

© Mark Angelo Bucay

Family: Oriolidae

Distinguishing features: bright yellow body with black nape and trailing edge of wings. Females have lighter yellow and black plumage.

Size (Total length): ~10.5 inches

***Pycnonotus goiavier* Scopoli, 1786**
Common Name: *Yellow-Vented Bulbul*

LC Least Concern | Re Resident

© John Benrich Zuñiga

Family: Pycnonotidae

Distinguishing features: brown-yellow body and wings with white eyebrow and chest and distinct yellow undertail coverts.

Size (Total length): ~7.5 inches

***Himantopus himantopus* Linnaeus, 1758**
Common Name: *Black-Winged Stilt*

Family: Recurvirostridae

Distinguishing features: white body and neck with black crown or back of neck, beak and wings. Characterized by long red legs.

Size (Total length): ~14 inches

© Yrah Joy C. Panizales

***Rhipidura nigritorquis* Vigors, 1831**
Common Name: *Philippine Pied Fantail*

Family: Rhipiduridae

Distinguishing features: dark brown plumage with white chest, body and underparts. Distinct fan-like tail with white tips. Has black neck band and white eyebrow.

Size (Total length): ~7.5 inches

© John Benrich Zuñiga

**Has both resident and migratory population*

***Actitis hypoleucos* Linnaeus, 1758**
Common Name: *Common Sandpiper*

© Mark Angelo Bucay

Family: Scolopacidae

Distinguishing features: back and wings brown gray in color and slightly mottled. White eyestripe from lores and top of ear. White throat and body. Can be easily distinguished by bobbing tail when foraging.

Size (Total length): ~8 inches

***Numenius phaeopus* Linnaeus, 1758**
Common Name: *Whimbrel*

© John Benrich Zuñiga

Family: Scolopacidae

Distinguishing features: has a decurved bill. Hind neck, back and wings mottled brown with light brown. White throat, belly and shanks.

Size (Total length): ~17 inches

***Tringa totanus* Linnaeus, 1758**
Common Name: *Common Redshank*

Family: Scolopacidae

Distinguishing features: red-orange longish legs. Has a white eyering. Upperpart light to greyish brown. Has Barred back and wings

Size (Total length): ~11 inches

© Benjo Salvatierra

***Aplonis panayensis* Scopoli, 1783**
Common Name: *Asian Glossy Starling*

Family: Sturnidae

Distinguishing features: black plumage all throughout the body but with metallic green sheen up close when exposed to sunlight. Has bright red eyes.

Size (Total length): ~8 inches

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Macrobenthos

Flatlay of various macrobenthic fauna

Arranged by:
John Benrich Zuñiga

MACROBENTHOS

Mangrove forest floors have a diverse and distinct assemblage of benthic organisms (Dissanayake and Chandrasekara 2014). Molluscs are said to be abundant in Southeast Asia's mangroves (Giesen 2007). This is supported by the typical dominance of the gastropods as benthic fauna in mangrove ecosystems (Kabir 2014).

A total of 14 macrobenthic species were observed in the Pagbilao Mangrove Experimental Forest while 21 species were identified in Catanauan Mangrove Plantation. Out of this, 11 belong to Phylum Mollusca and one belong to Phylum Arthropoda. In Catanauan Mangrove Plantation, a total of 22 species belonging to three taxonomic Phyla: Mollusca and Arthropoda were recorded (Table 4).

Table 4. Checklist of macrobenthic species recorded in Pagbilao and

Class	Family	Species	Pagbilao	Catanauan
Bivalvia	Cyrenidae	*Geloina expansa* Mousson, 1849	X	X
Bivalvia	Veneridae	*Gafrarium pectinatum* Linnaeus, 1758	X	X
Bivalvia	Veneridae	*Tapes literatus* Linnaeus, 1758		X
Gastropoda	Cerithiidae	*Cerithium coralium* Kiener, 1841	X	X
Gastropoda	Cerithiidae	*Rhinoclavis vertagus* Linnaeus, 1767		X
Gastropoda	Chilodontaidae	*Euchelus atratus* Gmelin, 1791		X
Gastropoda	Conidae	*Conus (Virgiconus)* Cotton, 1945		X
Gastropoda	Costellariidae	*Vexillum plicarium* Linnaeus, 1758		X

*X = present in the area

Continuation...

Class	Family	Species	Pagbilao	Catanauan
Gastropoda	Cypraeidae	*Monetaria annulus* Linnaeus, 1758		X
Gastropoda	Ellobiidae	*Cassidula nucleus* Gmelin, 1791	X	X
Gastropoda	Ellobiidae	*Ellobium aurisjudae* Linnaeus, 1758	X	
Gastropoda	Littorinidae	*Littoraria scabra* Linnaeus, 1758	X	X
Gastropoda	Littorinidae	*Tectarius tectumpersicum* Linnaeus, 1758		X
Gastropoda	Muricidae	*Chicoreus capucinus* Lamarck, 1822	X	X
Gastropoda	Nassariidae	*Nassarius niger* Philippi, 1849		X
Gastropoda	Neritidae	*Nerita planospira* Anton, 1838	X	X
Gastropoda	Potamididae	*Cerithidea quoyii* Hombron & jacquinot, 1848	X	
Gastropoda	Potamididae	*Pirenella alata* Philippi, 1849	X	X
Gastropoda	Potamididae	*Telescopium telescopium* Linnaeus, 1758	X	X
Gastropoda	Potamididae	*Terebralia palustris* Linnaeus, 1767	X	X
Gastropoda	Potamididae	*Terebralia sulcata* Born, 1778	X	X
Gastropoda	Ranellidae	*Monoplex nicobaricus* Röding, 1798		X
Malacostraca	Ocypodidae	*Uca* sp.	X	X

*X = present in the area

Scientific name:
Geloina expansa
Mousson, 1849

Habitat: Landward zone with long emersion period.

Length: 7 cm (common); 10 cm (max)

© John Benrich Zuniga

Scientific name:
Gafrarium pectinatum
Linnaeus, 1758

Habitat: Intertidal sandy areas

Length: 3.5 cm (common); 4.8 cm (max)

© Jose Isidro Michael Padin

Scientific name:
Tapes literatus
Linnaeus, 1758

Habitat: Shallow subtidal flats with sandy to muddy substrate

Length: 8.5 cm (common); 10.8 cm (max)

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© Jose Isidro Michael Padin

Scientific name:
Cerithium coralium
Kiener, 1841

Habitat: Found in mudflat areas.

Length: 3 cm (common); 5 cm (max)

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Scientific name:
Rhinoclavis vertagus
Linnaeus, 1767

Habitat: Found in intertidal sand flats

Length: 5 cm (common); 7 cm (max)

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Scientific name:
Euchelus atratus
Gmelin, 1791

Habitat: Found in shallow intertidal waters

Length: 0.5 to 2.1 cm

Scientific name:
Conus (Virgiconus) Cotton, 1945

Habitat: Intertidal to subtidal sandy areas.

Length: ~4.25 cm

© Ma. Marcia Santillan

Scientific name:
***Vexillum plicarium* Linnaeus, 1758**

Habitat: Sandy areas

Length: 3 to 6 cm

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Scientific name:
***Monetaria anulus* Linnaeus, 1758**

Habitat: Various shallow intertidal habitats

Length: 3 cm (common); 4 cm (max)

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Scientific name:
Cassidula nucleus
Gmelin, 1791

Habitat: Predominantly mangrove associate species

Length: ~1.6 to 1.9 cm

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Scientific name:
Ellobium aurisjudae
Linnaeus, 1758

Habitat: Found in both mangrove forests (nipa forests) and mudflat areas.

Length: 5 cm (common); 6 cm (max)

© Ma. Marcia Santillan

Scientific name:
Littoraria scabra
Linnaeus, 1758

Habitat: Mangal obligate; largely dependent on mangrove environments.

Length: 3 cm (common); 4.4 cm (max)

Scientific name:
Chicoreus capucinus
Lamarck, 1822

Habitat: Found on mangrove trees feeding on barnacles

Length: 9 cm (max)

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Scientific name:
Nassarius niger
Philippi, 1849

Habitat: Found in intertidal sandflats/mudflats

Length: 0.6 to 1 cm

© Ma. Marcia Santillan

Scientific name:
Nerita planospira
Anton, 1838

Habitat: Rocky substrates in shallow intertidal environments

Length: 2 cm (common); 3.5 cm (max)

© John Benrich Zuniga

© John Benrich Zuniga

Scientific name:
Cerithidea quoyii Hombron and Jacquinot, 1848

Habitat: Often attached to mangrove trees feeding on algae

Length: ~2.5 cm

© Jose Isidro Michael Padin

Scientific name:
***Telescopium telescopium* Linnaeus, 1758**

Habitat: Partly burrowed/covered in mud flats

Length: 11 cm (common); 13 cm (max)

© Ma. Marcia Santillan

Scientific name:
***Terebralia sulcata* Born, 1778**

Habitat: Below littoral zone or in mangrove swamps

Length: 5 cm (common); 6.5 cm (max)

References

Abantao SC, Apacible TC, Cortez SP, Pereda LT, Yllano OB. 2015. Mangrove Species Diversity and on-site Impact Assessment of Mangal Coastal Areas. Expert Opin Environ Biol . 4(3).

Almazol AE, Cervancia CR, Buot IE Jr, Gruezo WSM, Pampolina NM. 2013. Floristic Composition and Physiognomy of Pagbilao Mangrove, Quezon Province, Philippines. IAMURE Int. J Ecol Conserv. 34(1).

ASEAN Tropical Plant Data Base. 2005. [Accessed 2017 December]. http://211.114.2120/tropicalplant.

Aksomkoae S. 1993. Ecology and Management of Mangroves. Bangkok, Thailand: International Union for the Conservation of Nature.

BirdLife International. 2013. State of the world's birds: birds are very useful indicators for other kinds of biodiversity. [Accessed 2017 December]. http://www.birdlife.org/datazone/sowb/casestudy/79.

Brown B. 2004. Do Your Own Mangrove Action Project. Indonesia: Mangrove Action Project.

Das SS, Sur SD, Ghosh P. 2015. Phylogenetic relationships among the mangrove species of Acanthaceae found in Indian Sundarban, as revealed by RAPD analysis. Adv App Sci Res. 6(3): 179-184

Dissanayake N, Chandrasekara U. 2014. Effects of Mangrove Zonation and the Physicochemical Parameters of Soil on the Distribution of Macrobenthic Fauna in Kadolkele Mangrove Forest, a Tropical Mangrove Forest in Sri Lanka. Adv Ecol. 2014: 1-13.

Fernando ES, & Pancho JV. 1980. Mangrove trees of the Philippines. , *5*(1), 35 –54.

Fernando ES, Sun BY, Suh MH, Kong HK, Koh KS. 2004. *Flowering* Plants and Ferns of Mt. Makiling. Seoul National University, Korea: ASEAN-Korea Environmental Cooperation Unit,

Garcia KB, Malabrigo PL, Gevaña DT. 2014. Philippines' Mangrove ecosystem: status, threats and conservation. New York, NY: Springer.

Giesen W, Wulffraat S, Scholten L. 2006. Mangrove. Mangrove Guidebook for Southeast Asia. Volume 8. Bangkok, Thailand: FAO and Wetlands International.

International Union for the Conservation of Nature. 2016. Mangrove forests in worldwide decline. [Accessed 2017 January 17]. From https://www.iucn.org/content/mangrove-forests-worldwide-decline.

IUCN 2016. The IUCN Red List of Threatened Species. Version 2016. [Retrieved September 2016]. http://www.iucnredlist.org.

Janssen R, Padilla JG. 1996. Valuation and Evaluation of Management Alternatives for the Pagbilao Mangrove Forest. CREED Working Paper Series No. 9. [Accessed 2017 January 17]. http://www.prem-online.org/archive/17/doc/creed09e.pdf.

Jepson WL, Hickman JC. 1933. The Jepson manual : higher plants of California. Berkeley, California, USA: University of California Press,

Kabir M, Abolfathi M, Hajimoadioo A, Zahedi S, Kathiresan K, Goli S. 2014. Effect of mangroves on distribution, diversity and abundance of molluscs in mangrove ecosystem: a review. Aquac Aquar Conserv Legis. Volume 7(4): 286-300.

Kauffman JB , Donato DC. 2012. Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests. Bogor, Indonesia: Center for International Forestry Research

Kennedy RS, Gonzales PC, Dickinson EC, Miranda Jr. HC, Fisher TH. 2000. A guide to the birds of the Philippines. Great Clarendon Street, Oxford: Oxford University Press.

Lee SY. 2008. Mangrove macrobenthos: Assemblages, services, and linkages. J Sea Res. Volume 59(1–2):16-29.

National Geographic. 2007. Mangroves. [Accessed 2017 January 17]. http://ngm.nationalgeographic.com/2007/02/mangroves/warne-text.

[NRMC] Natural Resources Management Center. 1980. Assessment of forestry management problems and issues: A Delphi approach. Quezon City: Ministry of Natural Resources, Philippines.

Primavera JH, Sadaba RB. 2012. Beach Forest Species and Mangrove Associates in the Philippines. Iloilo, Philippines: SEAFDEC Aquaculture Department.

Palis HG. 2013. A Handbook of Beach Plants in the Philippines. Laguna, Philippines: Ecosystems Research and Development Bureau.

Primavera JH, Sabada RB, Lebata MJ, Altamirano JP. 2004. Handbook of Mangroves in the Philippines - Panay. Tigbauan, Iloilo, Philippines 5021: Aquaculture Department, Southeast Asian Fisheries Development Center.

Tomlinson PB, 1986. The Botany of Mangroves. Cambridge, UK: Cambridge University Press

The Plant List - A working list for all plant species. [Accessed 2016 October]. http://www.theplantlist.org/

Waycott M, McKenzie L, Mellors JE, Ellison JC, Sheaves MT, Collier C, Schwarz AM, Webb A, Johnson JE, Payri CE. 2011. Vulnerability of mangroves, seagrasses and intertidal flats in the tropical Pacific to climate change. Noumea, New Caledonia: Food and Agriculture Organization, Secretariat of the Pacific Community.

Walters BB, Rönnbäck P, Kovacs JM, Crona B, Hussain SA, Badola R, Dahdouh-Guebas F. 2008. Ethnobiology, socio-economics and management of mangrove forests: A review. Aquat Bot. *89*(2): 220-236.

World Register of Marine Species. [Accessed 2016 October]. http://www.marinespecies.org at VLIZ. doi:10.14284/170.

Zakaria M, Rajpar MN. 2015. Assessing the Fauna Diversity of Marudu Bay Mangrove Forest, Sabah, Malaysia, for Future Conservation. Diversity. 7:137-148.

Glossary

acute - more or less straight sides that tapers to end creating a sharp-pointed tip

acuminate - tapering in a more or less concave sides before reaching tip

adventitious – roots that grow in different part of a plant (e.g. roots on the branches)

alternate - one leaf per node; absent opposite node on the other side of the stem in the same level

alkaloids - nitrogenous substance from plants that can bring psychological effect to humans

apex - tip

aphrodisiac - substance that increases libido

apiculate - smooth sudden decrease in shape

asymmetric - not divided into equal parts

axil – upper angle between leaf and stem

axillary - growth arise from axil

catkin - a hanging cluster of spika (inflorescence)

calyx -collective term for sepals either fused or not the enclose the bud of flower

corrugated - a surface with groves alternately

capsule - an enclosed fruit containing more than a seed which open when ripe

cyme - convex inflorescence with flat-topped which the center or terminal flowers first open

elliptic - oval shaped that has widest in middle with pointed upper and lower tip

fissured - bark with cracks

habit - a tree's form

habitat - a location to which a living organisms live that meet its requirements to live

hypocotyl - sprout below the cotyledon; part of embryo

Inflorescence - flowers in cluster

keel - lower petals joining to form a structure (e.g. keel of a boat)

lenticel - tiny opening at stem for gas exchange

lenticellate - having numerous lenticels

mucronate - broad tip leaves with short pointed tip called mucro

obovate - widest part toward tip that is usually egg-shaped

pneumatophores - specialized aerial roots of mangroves in different shapes knee, conical, pencil

poultice - bandage

panicles - inflorescence with racemose branches or corymbs with stalked flowers

pedicel - stalk of a flower of an inflorescence

rachis - main axis of flower cluster

reflexed - folded backward

scales - small flakes covering attached in the surface of the fruit and leaves

serrate - sides with sharp teeth like saw

sessile - directly attached; absence of stalk

shaggy - rough thick hair

shrub - height is less than 5m with no distinct main stem

stilt root - also known as prop root that emerged from stem

Mangrove Phenology Calendar

Table 5. Phenological calendar of some mangrove species in Quezon.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Aegiceras corniculatum												
Avicennia marina												
Bruguiera gymnorrhiza												
Ceriops zippeliana												
Lumnitzera racemosa												
Rhizophora apiculata												
Rhizophora mucronata												
Rhizophora stylosa												
Sonneratia alba												
Xylocarpus granatum												

Legend: Budding; Flowering; Fruiting

Additional key for identification: Root Structure

Pencil –shaped pneumatophores of *Avicennia* spp. and *Sonneratia* spp.

Knee roots of *Bruguiera* spp.

Flaky root of *Ceriops spp.*

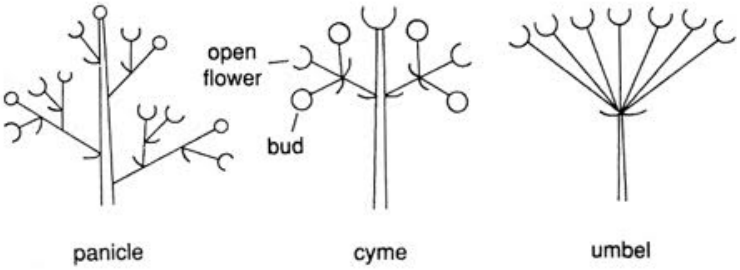
Cone-shaped root of *Xylocarpus moluccensis*

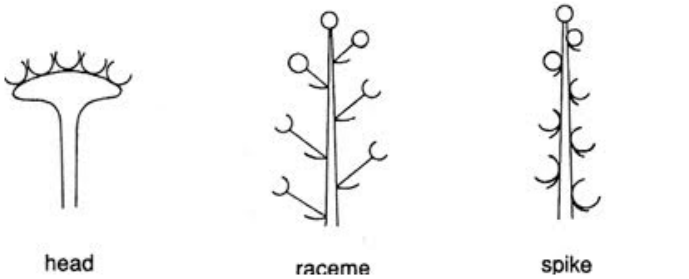
Prop roots of *Rhizophora* spp.

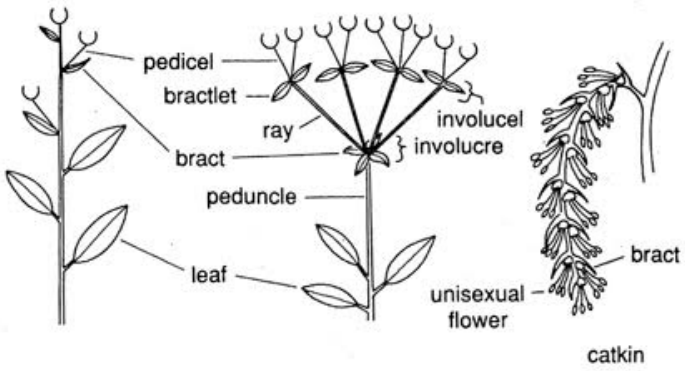
Tree form of *Osbornia sp.*

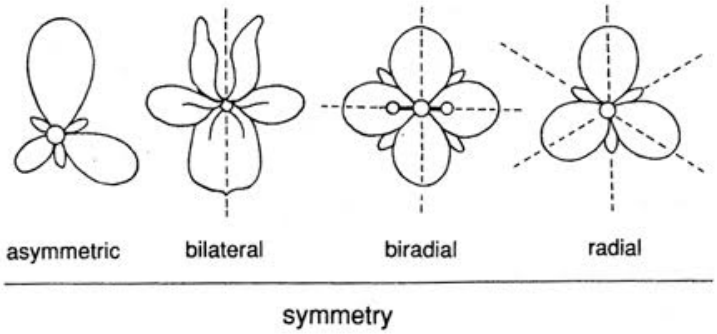
Additional key for identification: Inflorescence

Excerpt from: Jepson and Hickman 1993.

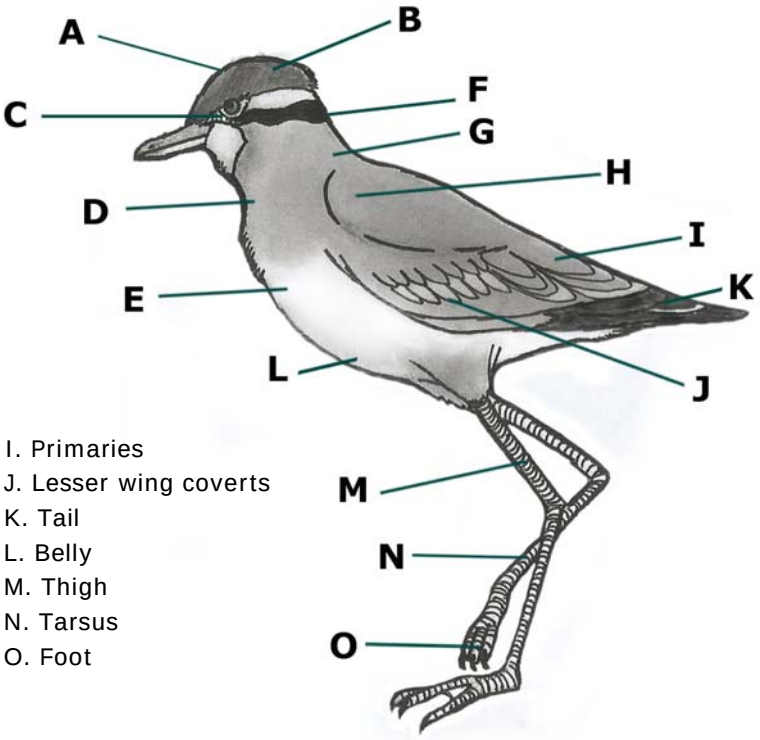








Additional key for identification: Bird Topography

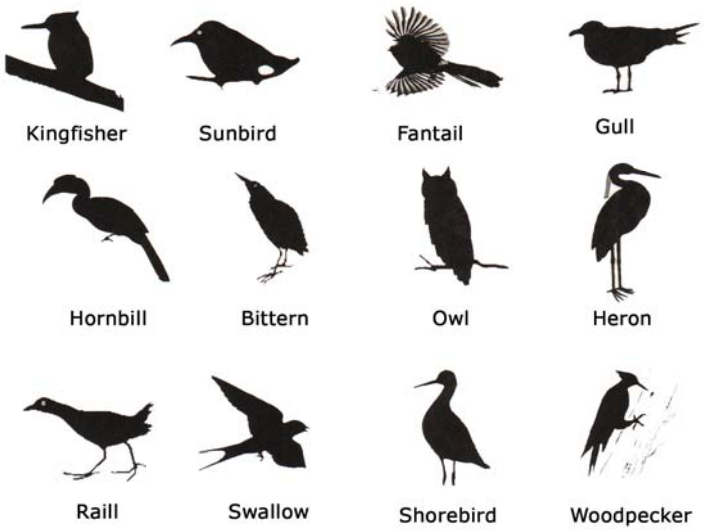


LEGEND:

A. Forehead
B. Crown
C. Lores
D. Neck
E. Chest
F. Eyestripe
G. Nape
H. Scapulars
I. Primaries
J. Lesser wing coverts
K. Tail
L. Belly
M. Thigh
N. Tarsus
O. Foot

Additional key for identification: Bird Shape

Excerpt from: IEC material published by ICRMP and Ecotourism Enterprise Development



INDEX TO COMMON NAMES

ABOUT THE AUTHORS

Ma. Lourdes Q. Moreno, *Ph.D.*
Supervising Science Research Specialist
Mangrove and Beach Forest Section
Coastal Zone and Freshwater Ecosystems
Research Division—ERDB

PhD Community Development, UPLB
BS and MS Zoology, UPLB

John Benrich M. Zuniga
Science Research Analyst
Candidate, MS Environmental Science, UPLB
BS Biology major in Wildlife Biology, UPLB

For. Riselle Ahillon-Evangelista
Science Research Technician III
BS Forestry, UPLB

For. Alvin S. Gestiada
Senior Science Research Specialist
MS Natural Resources Conservation, UPLB
BS in Forestry, UPLB

Mark Angelo C. Bucay
Science Research Technician III
BS Biology Major in Systematics, UPLB

Carmelita I. Villamor, *Ph.D.*
Chief Science Research Specialist
Coastal Zone and Freshwater Ecosystems
Research Division

Ma. Marcia M. Santillan
Laboratory Technician I

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